1 DESCRIPTION

OVERVIEW OF THE UNIT

The IC 2000 Series is a multi-function power meter. An optional data communications module can be fitted to a basic meter (on site) and the meter can be upgraded (at the factory) to accommodate profiling of 40 days complete data.

Pulse output is available on 5 sets of normally open, voltage free relay contacts. The relays are mounted inside the meter. All the connections, including the communications, when fitted, are screw terminals at the back of the meter. All the screws in the terminals are captive.

The front panel consists of a 40 character 2-line display and a set of readout selection buttons.

Broadly speaking, the meter is factory programmed and provides a small range of functions which are programmable by the user. The standard meter is supplied with PEAK MD Reset, CT ratio setting and CT Polarity check available for user programming. It is also available with additional controllability (i.e. a greater range or programmable functions) to special order.

FIRST CHECK THE CONTENTS OF YOUR PACKAGE

It should contain:

1. Meter (Quantity 1).
2. Fixing brackets with screws inserted (Quantity 2).
3. Communications cassette if specified (Quantity 1).
4. Installation and operation manual.

The functions, common to all IC 2000 Series meters, are described in Function 12, 13, 14 and 50. An addendum carrying the same number as the function number will be issued with every additional function which is ordered.

PULSE OUTPUTS

Up to 5 voltage free output relays can be fitted in the meter. Three of them have their status reflected in the LEDs numbered 1, 2 and 3 on the front panel; the other two are for additional facilities and can be programmed as required to special order. Pulse length is programmable to order.

As supplied, Relay 1 indicates KWh, Relay 2 indicates KVAh and Relay 3 indicates KVARh. Every relay (and its associated LED if applicable) operates for the duration of the pulse length every time one unit of measurement is counted. The LEDs provide both a visual indication and a pulse output facility for testing the meter from the front panel.

CONTENTS

AUTOMETERS

2 INSTALLATION

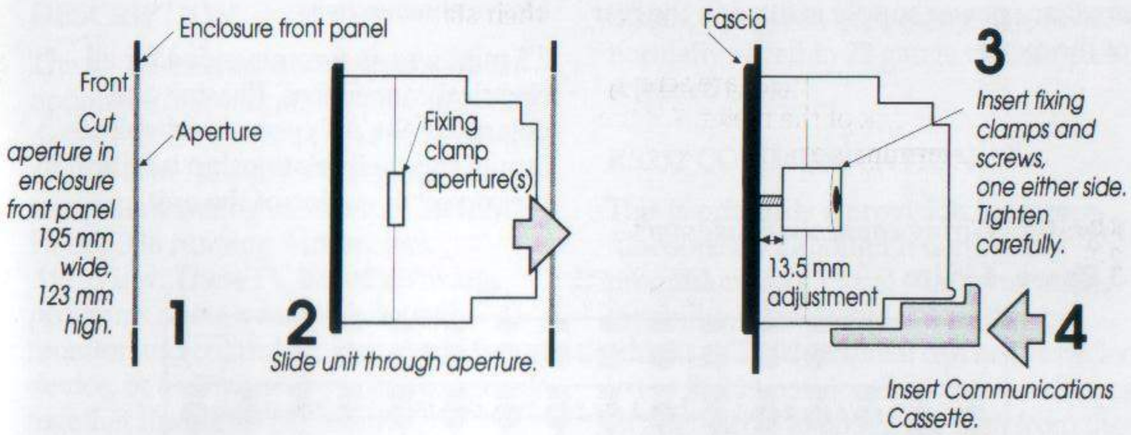
INSTALLATION OF THE METER

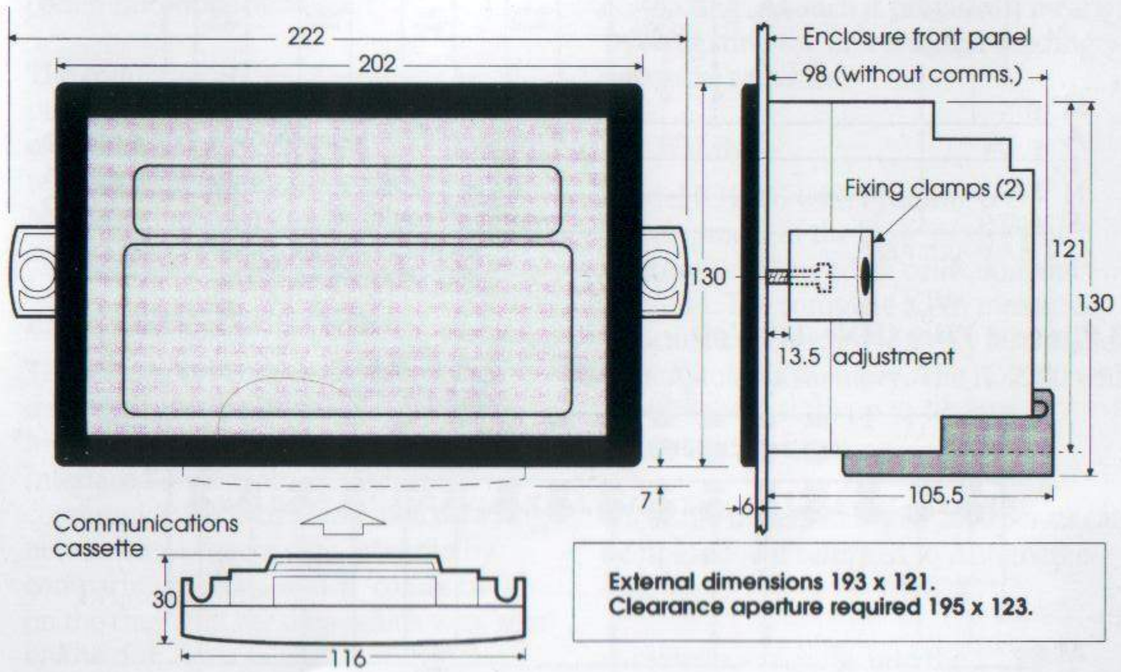
Mount the meter so that the front panel is vertical. A typical panel would be a switchgear cabinet door. The meter requires depth behind the panel of 115 mm excluding wiring. Prepare a single rectangular hole 195 mm wide and 123 mm high.

LOCATION

The IC 2000 Series should be mounted in dry dirt free environments away from heat sources and very high electric fields. Temperatures should not exceed 50°C (112°F) or fall below 0°C (32°F).

Figure 1. Installation details





External dimensions 193 x 121.
Clearance aperture required 195 x 123.

For the IC2000 Series with communications, after cutting the clearance aperture, remove the Cassette Blanking Plate, insert the meter through the front of the aperture, fix — with the two Fixing Clamps — then fit the Communications Cassette and secure, using the same two screws which held the Blanking Plate in position.

3 WIRING INFORMATION

POWER SUPPLY

The standard IC 2000 Series meters are powered by 230 Volts AC (47 to 66 Hz) at 0.2 Amps. The units can be powered from a dedicated fused feed, or may be powered by the voltage source which they are monitoring, as long as it is a 230 Volt System. As an option the meter can be supplied with a 110 Volt power supply. A removable protection fuse for the auxiliary power supply is fitted in the rear of the meter.

WIRING

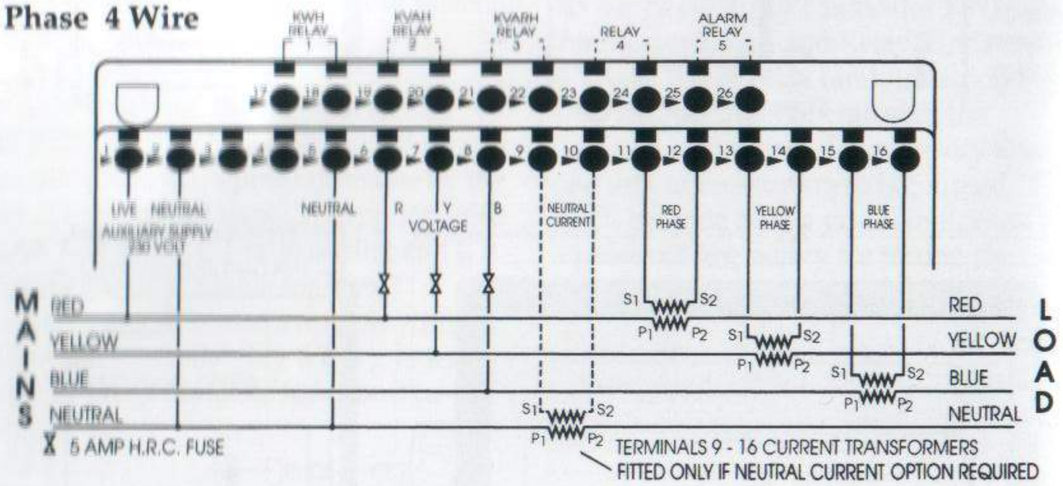
Electrical and communications connections are made directly to the back of the meter. Electrical connections are made to terminals 1-16, pulse output relays numbered 17-26, and the RS485, RS232 communications directly to the communications cassette (see Figures 2 and 5).

Electrical connections

2.5 mm² wire is recommended for all electrical connections. Phasing and polarity of the AC current and voltage inputs and their relationship is critical to the correct operation of the unit.

Figure 2. Wiring connection diagrams.

3 Phase 4 Wire



3 Phase 3 Wire (HV) 110 Volt

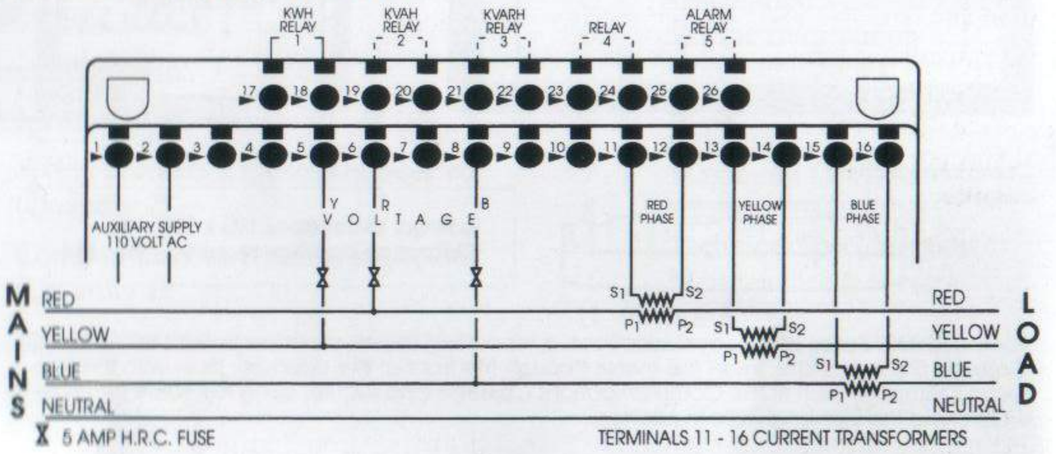


Figure 3. Wiring connection for pulse outlet relays

Pulse outlet relays	Terminals	Value	Closure time
1. KWh	17 - 18	1 KWh	100 ms
2. KVAh	19 - 20	1 KVAh	100 ms
3. KVARh	21 - 22	1 KVARh	100ms
4. Programmable	23 - 24	-	
5. Programmable	25 - 26	Maximum Demand Alarm	

4 COMMUNICATIONS (IF FITTED)

DESCRIPTION

The IC 2000 Series is equipped with an optional communications port, allowing data transfer between the remote device and an IBM PC 386 (or compatible) host computer running SCADA, or an IBM PC-XT 386 running Autometers AutoView. These PC based software programs allow a user to remotely monitor and control either a single remote device, or a number of devices connected together through a common communications network.

The communications cassette is a small plug-in unit using a DIN 41612 Class 1 connector. It can be fitted on site without removing the meter and provides screw terminal connectors for both the RS485 and RS232 ports (Figure 5).

RS485 COMMUNICATION

The RS485 port is used exclusively for data transmission. It uses a form of the high integrity HPIL (Hewlett Packard Interface Loop) protocol. The RS485 communication is implemented on a ring network and checks data integrity by comparing the data which 'comes back' on the ring with the data which was 'sent' on the ring.

Electrically the RS485 network is completely standard using 2-wire bipolar pulsing and is subject to the usual limitations of 1000 metres maximum distance between each meter. The RS485 is normally wired in 22 gauge twisted pair screened cable.

RS232 COMMUNICATION

This is primarily a provision for future functionality although it is currently programmed as a local communications capability. This provides a facility by which a VT 100 terminal can be connected to the RS232 port locally to extract data as an alternative to taking the data from the RS485 ring. As such it provides a means of interrogating the unit without needing specialist software.

PROFILING

Model IC 2700 with Profiling is a development of the basic model which features profiling (data collection and logging). The complete KWh measured information is recorded every 30 minutes in non-volatile memory. The IC 2700 with Profiling will store up to 40 days information.

All of the meters in the IC 2000 Series can be upgraded if returned to Autometers Ltd.

A cassette which fits into the Communications Port is currently under design. This will enable the meter to be upgraded without the necessity to remove the meter from location.

SCADA AND AUTOVIEW

A host computer running SCADA or AutoView software may communicate with one or more IC 2000 Series remote devices. These programs will display all data normally provided through the front panel display of each device. The user may also remotely program any set-up parameter(s), e.g. C.T. ratio or Maximum Demand Alarm, of a selected device.

SOFTWARE UPDATING VIA THE COMMUNICATIONS PORT

Future IC 2000 Series software updates, when made available by Autometers can be quickly performed via the RS485 port.

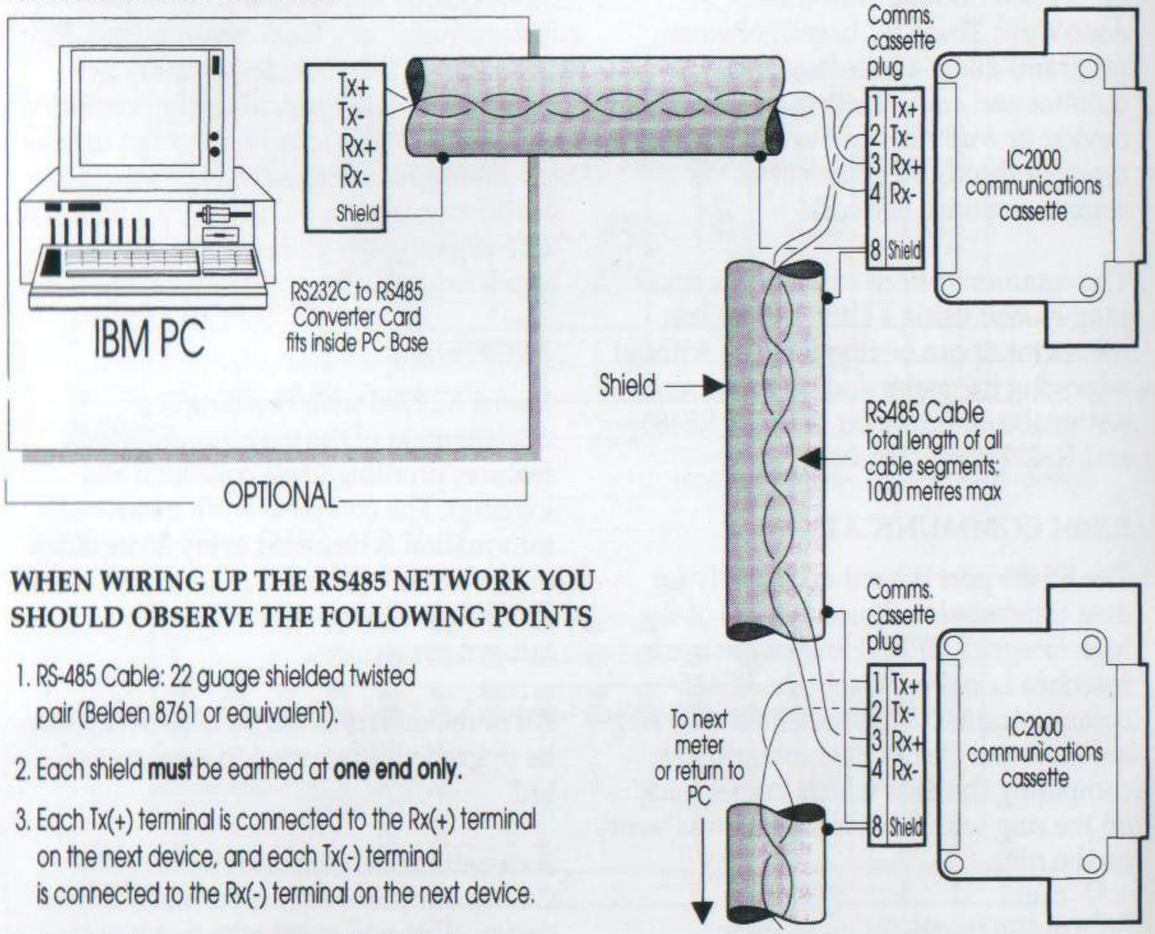
COMMUNICATIONS PROTOCOL

To communicate with SCADA or other software packages via the RS485 Communication Port, an IC 2000 Series Protocol will be required.

CAUTION

It is important that the shield of each leg of the RS485 cable be connected **at one end only.**

Figure 4.
Communication connections



WHEN WIRING UP THE RS485 NETWORK YOU SHOULD OBSERVE THE FOLLOWING POINTS

1. RS-485 Cable: 22 guage shielded twisted pair (Belden 8761 or equivalent).
2. Each shield **must** be earthed at **one end only.**
3. Each Tx(+) terminal is connected to the Rx(+) terminal on the next device, and each Tx(-) terminal is connected to the Rx(-) terminal on the next device.
4. Up to 15 devices are allowed on the RS485 ring.
5. Use terminal 8 (NC) spare terminal for linking Earth Shields.

COMMUNICATION CONNECTIONS

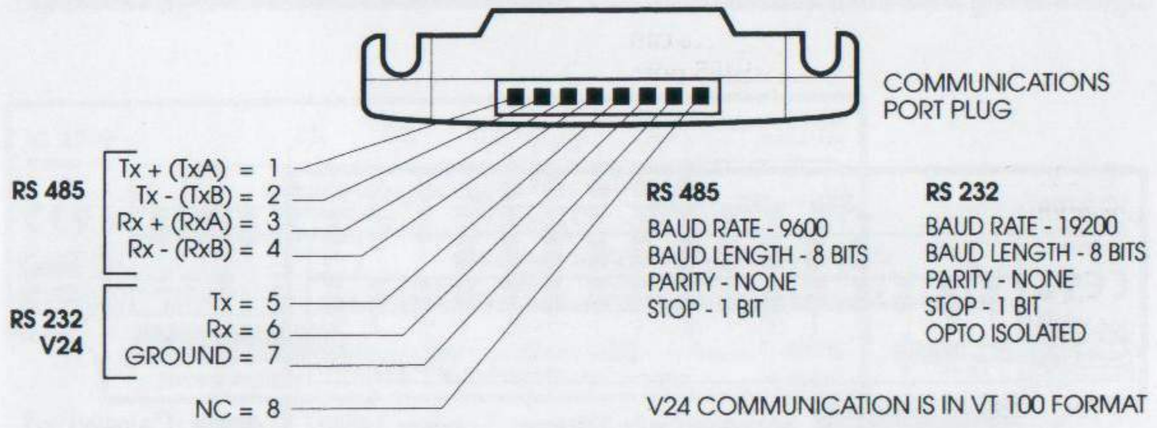
The IC 2000 Series performs remote communications using the RS485 communication standard. If a computer is to be connected to the RS485 network to perform remote analysis, then the host computer requires an internal RS232c to RS485 converter board and Autometers communication protocol.

All field service work including running diagnosis, testing, software upgrades etc., are performed via the communication link.

COMMUNICATION CASSETTE CONNECTIONS *(if fitted)*

RS485 communications connections are made via a 22 gauge shielded twisted pair cable. Figure 5 describes communications connections.

Figure 5. Communication cassette connections.



ENGINEER — PLEASE ENTER DETAILS OF YOUR COLOUR CODE CONNECTIONS:

RS485	Tx + (TxA)	= 1	.....
	Tx - (TxB)	= 2	.....
	Rx+ (RxA)	= 3	.....
	Rx - (RxB)	= 4	.....
RS232	Tx	= 5	.....
	Rx	= 6	.....
	GROUND	= 7	.....
	NC	= 8	.....

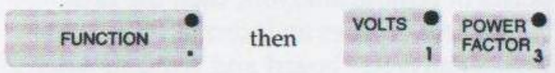
ADDITIONAL NOTES

5 PROGRAMMING THE METER

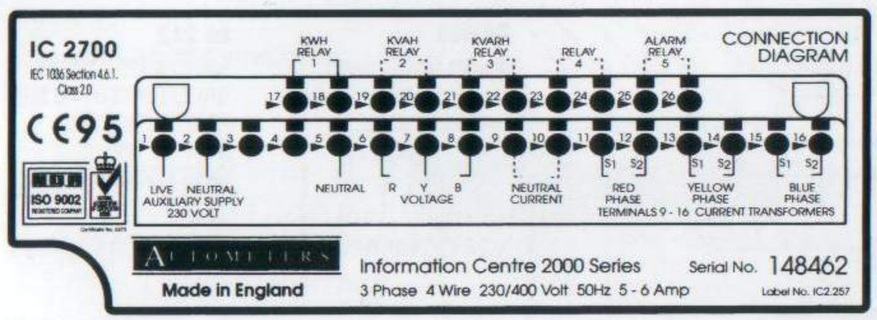
PROGRAMME THE C.T. RATIO
For C.T. selection, see page 16.

Your Current Transformer Ratio requires to be programmed into this meter. Please follow these instructions precisely:

1. Press FUNCTION, then 1, then 3 (Numbers on the bottom right of the keys).



2. Enter Password (The Serial Number on the reverse side of your meter) — six digits, starting from the left hand side.



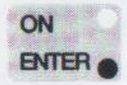
← Password

3. The display will change to ENTER C.T. RATIO.

Type in the number with the first digit on the left e.g. 2500/5 Type 2 then 5 then 0 then 0.

If the C.T. Ratio is required with less than four digits (e.g. 300/5 Amp), start first left hand digit with 0 e.g. ENTER C.T. RATIO — 0300/5.

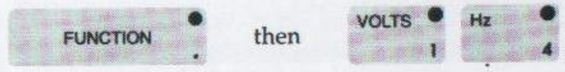
4. When complete press ENTER.



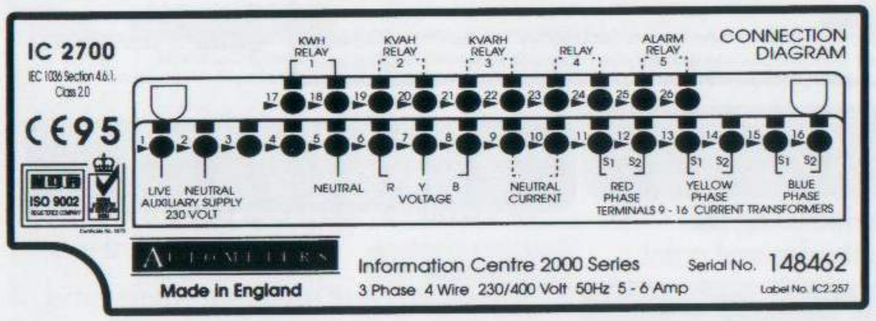
PROGRAMME THE V.T. (P.T.) RATIO
For Voltage (Potential) Transformer selection, see page 16.

Your Voltage (Potential) Transformer Ratio requires to be programmed into this meter. Please follow these instructions precisely:

1. Press FUNCTION, then 1, then 4 (Numbers on the bottom right of the keys).

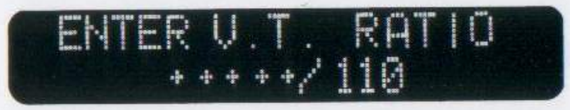


2. Enter Password (The Serial Number on the reverse side of your meter) — six digits, starting from the left hand side.



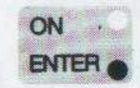
← Password

3. The display will change to ENTER V.T. RATIO.



Type in the primary voltage (potential) required with the first digit on the left. maximum 45,000.

If the V.T. Ratio is required with less than five digits (e.g. 6000/110 Volt), start first left hand digit with 0 e.g. ENTER V.T. RATIO — 06000/110.

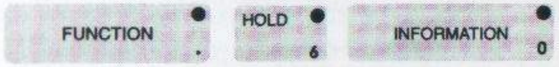


4. Press ENTER.

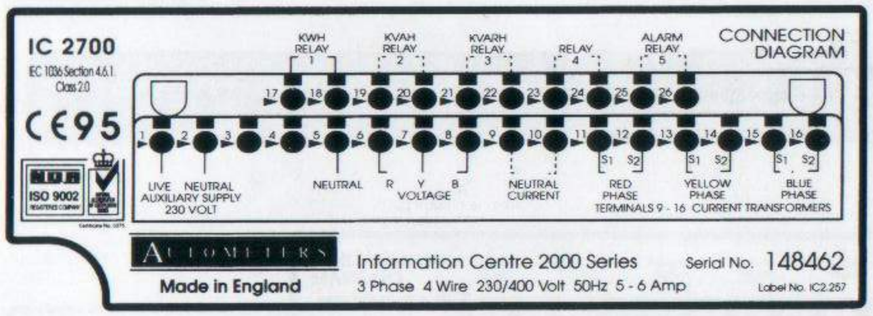
PROGRAMMING THE PULSE VALUE AND PULSE DURATION (TIME)

Your Pulse Value and Pulse Time are factory set at 1.0 KWh and 100 ms. If you require different values, please follow these instructions precisely:

1. Press FUNCTION, then 6, then 0 (Numbers on the bottom right of the keys).



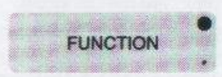
2. Enter Password (The Serial Number on the reverse side of your meter) — six digits, starting from the left hand side.



← Password

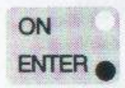
3. The display will show the factory setting.

Type in the required value using the FUNCTION button as the decimal point.



If for example the Pulse Value is required to be programmed to 10 KWh per pulse, enter 1, then 0, then decimal point (FUNCTION), then 0, then 0, then 0.

4. Press ENTER.



IMPORTANT. There are 6 digits available to programme the Pulse Value. It is imperative that the decimal point is inserted into the new value e.g. 1.0000 KWh, 10.000 KWh and 100.00 KWh.

5. After pressing the ENTER button it will automatically go to the next display. Enter Pulse Time by typing in the number with the first digit on the left e.g. 1500 ms — type 1, then 5, then 0, then 0.

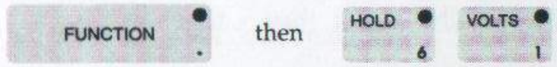
If the Pulse Value is required with less than 4 digits (e.g. 100 ms), start the first left hand digit with 0, i.e. enter Pulse Value 0100.

6. When complete press ENTER.

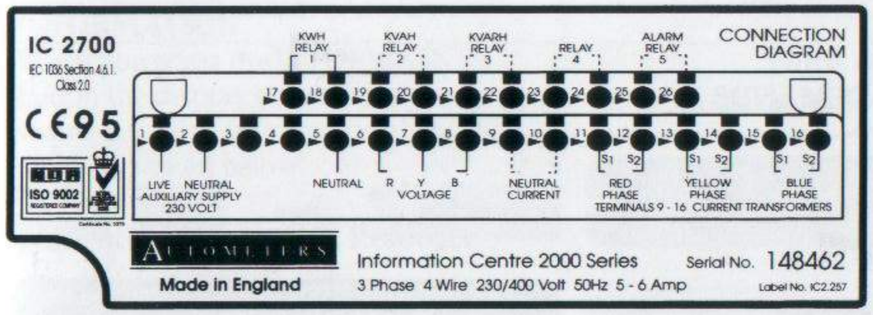
PROGRAMMING THE MAXIMUM DEMAND ALARM

Your Maximum Demand alarm requires to be programmed into this meter. Please follow these instructions precisely:

1. Press FUNCTION, then 6, then 1 (Numbers on the bottom right of the keys).



2. The display will show — Enter Password (The Serial Number on the reverse side of your meter) — six digits, starting from the left hand side.



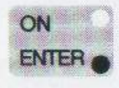
← Password

3. The display will show —

The Maximum Demand alarm value consists of 8 digits and must be entered as a value in **Watts**.

To programme the alarm and activate the relay at (for example) 450 KW, start the first two left hand digits with 00, then 4, then 5, then 0000. The first two 00s are used purely to fill the 8 digit sequence.

4. When complete press ENTER.



M.D. ALARM OPERATION

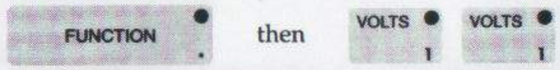
1. When the Maximum Demand alarm value has been reached or exceeded, Relay 5 will close and remain closed until you reset the alarm.

To reset the alarm see below.

This will not reset the Maximum Demand to zero, and ensures that you are recording the full power consumed in your Maximum Demand time period.

When the M.D. alarm has been activated and reset, it will become active at your next new time period.

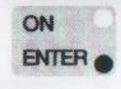
TO RESET M.D. ALARM (OPEN RELAY 5)



1. Press FUNCTION then 1, then 1.

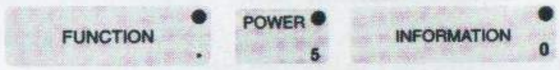
2. Display will show

3. Press ENTER



CHECK C.T. POLARITY

Press FUNCTION, then 5, then 0.

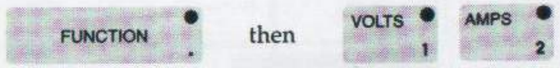


Display will show —

The Plus mark "+" indicates the C.T. is correctly connected.
If a '-" sign is displayed, this indicates the C.T. connection is incorrect.

RESET MAXIMUM DEMANDS

1. Press FUNCTION, then 1, then 2.



2. Display will show —

3. Press ENTER.

---

6 OPERATION

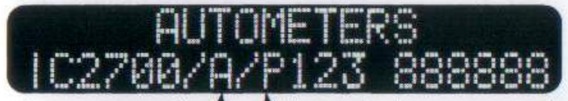
Once the meter is installed and the functions have been set (see below) the only operation is that of taking readings from the front panel readout. If the data is collected using the RS485 network, no operation is required at all.

INFORMATION

When you press the INFORMATION button the display cycles through a sequence giving information about the meter as shown below.

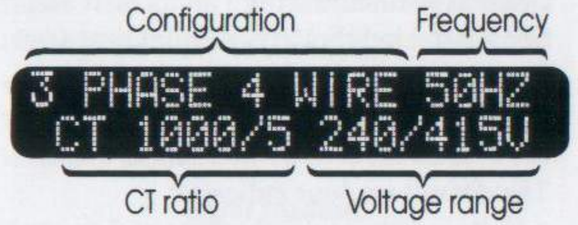
Sequence of Information Readouts

First readout



Type number
Software version
Pulse
Relays
Meter number

Second readout



Third readout

Fourth readout

Fifth readout

FUNCTIONS AT A GLANCE

- Function 11 - Switches off Maximum Demand Alarm.
- Function 12 - Reset all the Maximum Demand Registers.
- Function 13 - Programme C.T. Ratio.
- Function 14 - Programme V.T. Ratio.
- Function 50 - Check C.T. Polarity.
- Function 60 - Programme details of Pulse Output Values.
- Function 61 - Programme Maximum Demand Alarm.

FRONT PANEL
The display comprises 2 lines each of 20 characters. Each readout is maintained for 1 minute unless you press HOLD, in which case it is maintained for 5 minutes. It will not stay on indefinitely. When it times out it reverts to a default readout for five minutes before blanking. You can restore the default readout by pressing ENTER. The default readout indicates:

- Voltage between each phase and neutral on the upper line.
- Current flowing in each phase on the lower line.

A typical default readout is shown below.

```
R240  Y240  B240  V
R500  Y480  B300  A
```

VOLTS
Press the VOLTS button to obtain a readout or voltage between each phase and neutral on the upper line and between one phase and another on the lower line. A typical readout is shown below.

```
R  240 Y  240 B  240
RY 415 YB 415 BR 415
```

AMPS
Press the AMPS button to obtain a readout of Current in each phase and a total of all three phases. A typical readout is shown below.

First readout

```
R539.9 Y544.8 B541.9
TOTAL = 1626.6/AMPS
```

NEUTRAL AMPS
If fitted will be displayed as indicated below and will follow AMPS display

Second readout

```
NEUTRAL LINE CURRENT
    544.8 AMPS
```

POWER FACTOR
Press the POWER FACTOR button to obtain a separate readout of power factor in each phase. Negative value indicates current lagging, unsigned value indicates current leading. A typical readout is shown below.

```
   POWER FACTOR
R1.00  Y1.00  B1.00
```

FREQUENCY
Press the Hz button to obtain a separate readout of the frequency of each phase. A typical readout is shown below.

```
    FREQUENCY
R50.0  Y50.0  B50.0
```

POWER
Press the POWER button, this causes the display to cycle through readouts of W, VA and VAR. Each readout gives the power in each phase and a total. At the end of the cycle the display reverts to the default readout. A typical readout is shown below.

First readout

```
 R129  Y131  B120
TOTAL = 380.00 KW
```

Second readout

```
 R129  Y131  B120
TOTAL = 380.00 KVA
```

Third readout

```
R80.1  Y89.7 B80.15
TOTAL = 249.95 KVAR
```


7 MAXIMUM DEMAND

MAXIMUM DEMAND
KWh MD, KVAh MD and KVARh MD
These are the maximum demands of the three parameters and each has a cycle of two readouts each of which is maintained for 10 seconds (unless you press HOLD). In the first readout the upper line gives the total consumption (in KWh) since the meter was commissioned and is not resettable. The lower line gives the PEAK MD in any period (in W) since the meter was last reset; it corresponds directly with the "slave pointer" on a mechanical meter.

The second gives the period length and the MD in the present period on the upper line. This MD value corresponds directly with the "driver pointer" on a mechanical meter. The lower line indicates how much of the present period has elapsed. Both MD and PEAK MD readouts update every one minute. A typical first and second readout is shown below.

First readout

```
7426.9KWH
PEAK MD  130.65KW
```

Second readout

```
30 MINS MD 130.65KW
12 MINS INTO PERIOD
```

KVAh and KVARh give similar readout sequences.

MANUAL RESET OF MAXIMUM DEMAND

- Function 12 - manual reset which resets the Time into Period, the MD for the period so far and the PEAK MD all to zero. (If manual reset is not used the time and period MD, but *NOT* the PEAK MD, are reset automatically at the end of every period).

8 POTENTIAL AND CURRENT TRANSFORMER SELECTION

P.T. AND C.T. TRANSFORMER SELECTION

For proper monitoring, correct selection of C.Ts. and P.Ts. (if required) is critical. The following paragraphs provide the information required to choose these transformers.

P.T. Selection

Whether or not potential transformers (P.Ts.) are required depends on the nature of the system being monitored, the voltage levels to be monitored, and the input option of the IC 2000 Series.
The IC 2000 Series may be used for direct connection to 120/208, 220/381, 230/400, 240/415, or 277/480 4-wire Wye. For high voltage Potential Transformers are used (P.Ts.).

P.Ts. are used to scale down the system L-N (Wye) or L-L (Delta) voltage to 110 Volts full scale. The P.Ts. are selected as follows:

a) Wye (Star): P.T. primary rating = system L-N voltage or nearest higher standard size.
P.T. secondary rating = 110 Volts.

b) Delta: P.T. primary rating = system L-L voltage.
P.T. secondary rating = 110 Volts.

P.T. quality directly affects system accuracy. The P.Ts. must provide good linearity and maintain the proper phase relationship between voltage and current in order for the Volts, KW, and PF readings to be valid.

C.T. Selection

The IC 2000 Series uses current transformers (C.Ts.) to sense the current in each phase of the power feed. The selection of the C.Ts. is important because it directly affects accuracy.

The C.T. secondary rating, depends on the current input option installed in the IC 2000 Series. The standard IC 2000 Series current input rating is 5 Amps. A 1 Amp input option is also available.

The C.T. primary rating is normally selected to be equal to the current rating of the power feed protection device. However, if the peak anticipated load is much less than the rated system capacity then improved accuracy and resolution can be obtained by selecting a lower rated C.T. In this case the C.T. size should be the maximum expected peak current +25 %, rounded up to the nearest standard C.T. size.

Other factors may affect C.T. accuracy. The length of the C.T. cabling should be minimised because long cabling will contribute to inaccuracy. Also, the C.T. burden rating must exceed the combined burden of the IC 2000 Series, plus cabling, plus any other connected devices (burden is the amount of load being fed by the C.T., measured in Volt-Amps).

Overall accuracy is dependent on the combined accuracies of the IC 2000 Series, the C.Ts., and the P.Ts. (if used).

9 TECHNICAL SPECIFICATIONS

CONFORMANCE

Conforms to IEC 1036 Section 4.6.1, accuracy Class 2.0, or Class 1.0 if specified.

Electromagnetic compatibility CE 95.

Quality Control ISO 9002.

Certificate No. 0275

MEASUREMENTS

Measurement ranges
The unit is designed for measuring 3-phase in a 4-wire star configuration, and 3-phase 3-wire in a Delta configuration.

Volts:
± 10% nominal voltage.

Accuracy:
All measurements better than 2%, or 1% if specified.

Burden:
Current burden less than 1 VA.

Drift:
Negligible, self-compensating circuit.

Display:
20 characters x 2 lines.
Character size 5.92 mm wide x 8.32 mm high. Clear digit on a dark blue background.
Negative mode with LED back lighting.

Membrane switch:
Operating force 100 - 500 crs.
Switch life 8 - 10 million operations (IP65 sealed).

OUTPUTS

Voltage free relays:
A maximum of 5 programmable relays are available.

Pulse width (all relays):
Factory programmable, default value 100 ms.

Usage of relays (default configuration):
Relay 1 indicates kWh, Relay 2 indicates KVAh and Relay 3 indicates KVARh. Relays 4 and 5 are future provision. All 5 relays factory programmable to operate on any parameter.

Pulse value:
Programmable default value 1.0.

Relay contacts:
Maximum switching voltage 350 V DC or Peak AC. Maximum switching current 0.75 Amp (Switching Power 30 VA).

RS485 communications port (if fitted):
Up to 38,400 bits/sec using a form of high integrity HPIL protocol.

RS232 communications port (if fitted):
Future provision but available for local interrogation of data.

Power supply (auxiliary):
220 to 250 VAC, 50 or 60 Hz.

Functions supplied as standard:
MD Reset (function 12), C.T. ratio (function 13) and C.T. polarity checking (function 50).

Data profiling (if fitted):
Measurements of kWh recorded every 30 minutes. All values held for 40 days.

PHYSICAL

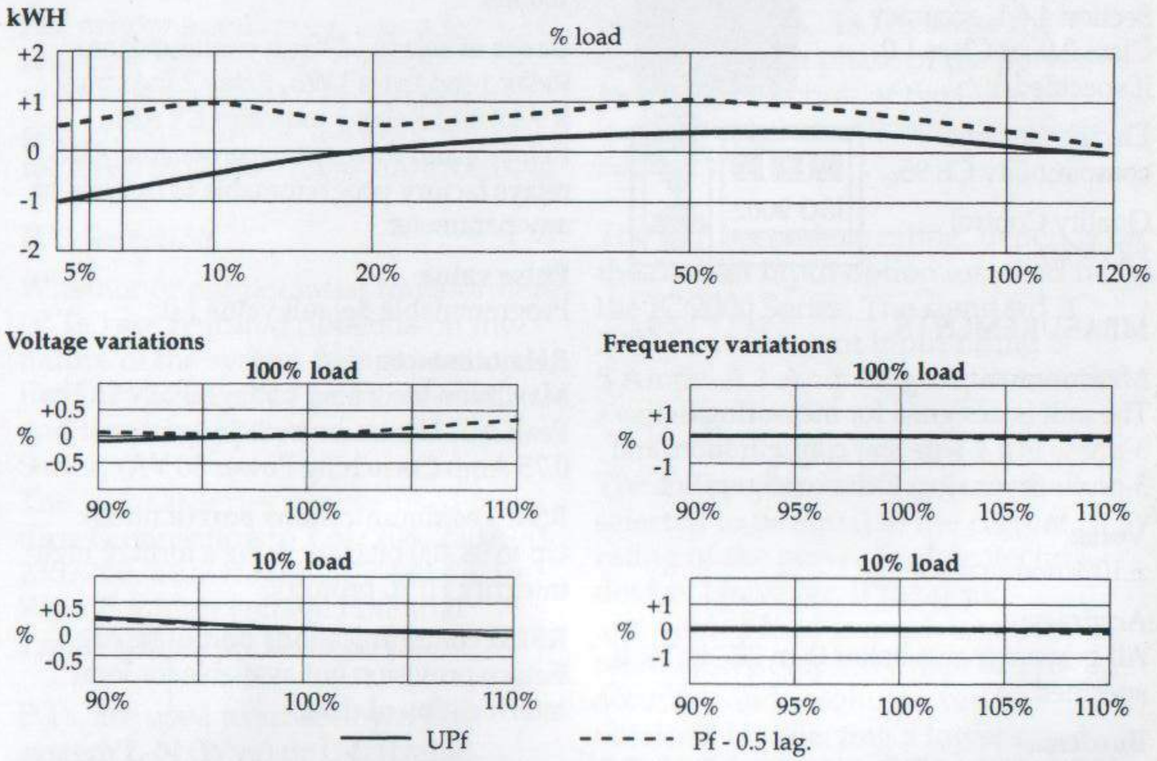
Operating Temperatures: 0°C to +50°C.
Storage Temperatures: -10°C to +70°C.
Dimensions (mm): 222 (W) x 130 (H) x 105.5 (D) excluding connectors.
Panel Cutout: 195 x 123 mm.
Weight: 1.25 kg, excluding any external transformers.

Please specify any additional functions required.

TYPICAL PERFORMANCE CHARACTERISTICS AT 50 Hz

Figure 6.

Graph showing load curve with balanced load applied



10 MAINTENANCE AND SERVICE

MAINTENANCE

The IC 2000 Series contain a Lithium battery back storage for non-volatile memory. The minimum rated life of the battery is 10 years. When a battery requires replacing, contact Autometers. Other than battery replacement, the IC 2000 Series of meters do not require any regular maintenance.

CALIBRATION

The calibration interval for the IC 2000 Series depends on the user's accuracy requirements.
Contact Autometers for calibration procedure details and equipment requirements.

FIELD SERVICE CONSIDERATIONS

In the unlikely event that an IC 2000 Series unit should fail, it will generally be serviced by exchanging the unit for a replacement unit. The initial installation should be done in a way which makes this as convenient as possible:

1. A C.T. shorting block should be provided so that the IC 2000 Series current inputs can be disconnected without open circuiting the C.Ts. The shorting block should be wired so that protective relays are not affected.

2. All wiring should be routed to allow easy removal of the connections to the IC 2000 Series terminals.

11 SOFTWARE INFORMATION